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ABSTRACT

To test whether the traditionally inferior performance in mathematics of girls relative to boys is the result of sex stereotyping, 2,000 sixth- to twelfth-grade boys and girls were administered tests in mathematics aptitude and tests to measure the strength of sex-role stereotyping. The results showed that at all levels subjects displayed no sex-related differences in their aptitude for mathematics, but subjects of both sexes tended to see mathematics as a male domain. On the attitudinal measures, girls at all levels showed less confidence in their mathematical abilities than did boys. (MPB)

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Girls' Attitudes toward Mathematics: Implications for Counseling[1]

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In the last two years I have been very much involved in the study of girls' attitudes toward mathematics and how these relate to mathematics achievement and the election of mathematics courses. Most of you are aware of the fact that it is commonly believed that beginning at least in adolescence, females are not so capable as males in mathematics, especially higher mathematics. The scarcity of women in the math-science fields is also well known. How and why does this happen?

As is often the case when one gathers a great deal of new data, unexpected results emerged. Girls did not necessarily perform more poorly than boys even in higher mathematics. When they did perform more poorly, it was in a context highly suggestive of the negative influence of socio-cultural factors.

Design and Procedure

In order for you to understand and weigh these results more adequately for yourself, let me briefly outline the design of the studies and the procedures.

The subjects were approximately 2000, 6-12th grade male and female students in the public schools of a mid-western city. They were nearly all white. They were selected by mathematics class and tested in their own classrooms under conditions of anonymity. They were given a variety of cognitive and attitudinal measures during the years 1975 and 1976. These included measures of mathematics achievement, verbal skill (vocabulary), spatial visualization and eight social-cultural measures. The latter were Likert-type scales, of good reliability, specially devised

for this investigation. They included variables which for either empirical or theoretical reasons could be thought to influence the learning of mathematics differentially by the two sexes. The attitudes of mother, father and teacher toward one as a learner of mathematics, attitude toward success in mathematics (a kind of fear of success measure), perception of mathematics as a male domain, perceived usefulness of mathematics and effectance motivation in mathematics. The latter is a kind of joy in problem solving developed from White's theoretical concept of effectance motivation, i.e. a desire to create effects, a kind of investigative curiosity.

Results and Discussion

Sex-Related Differences

So far as the contention that girls are relatively poorer in mathematics than boys, in grades 6 to 8 girls did as well as boys on a variety of math achievement tests ranging from computation to problem solving. This was true in three of the four attendance areas. There were also no differences between boys and girls in vocabulary or spatial visualization scores. At the high school level no difference was found between the sexes in mathematics achievement in two of the four attendance areas and when occurring, these differences were very small, a matter of about two test items. No difference between the sexes was found in vocabulary scores and no sex-related difference in spatial visualization was found in two of the four attendance areas. Clearly the image of female incapacity in mathematics does not square with these data.

This is the first message I'd like to give you as counselors, teachers and therapists. Girls and women can do mathematics very well and are not at all necessarily handicapped in this area.

For those of you who are skeptical, let me explain that the reason these results showed so few sex-related differences probably has to do with the fact that controls were better in this study, especially in regard to previous mathematics courses. Some investigators have drawn conclusions about girls' comparative inability in mathematics on the basis of data from groups in which the boys had more training in mathematics than girls. Unfortunately those results have been incorporated in the literature and have served to bolster certain common and traditional views.

Let us now turn more specifically to the results of the attitude scales. These attitudes related significantly to mathematics achievement. It had often been said that females do not pursue math-science careers for want of the effectance motivation, that joy and intrigue in problem solving. No evidence at all was found to support this view. In fact, in some instances girls reported significantly greater effectance motivation than boys.

As counselors and teachers one must not take refuge in the belief that girls are not interested in mathematics.

The results for the perceived attitudes of mother and father toward the student as a learner of mathematics generally showed more positive attitudes for boys, especially at the high school level. Interestingly enough and consistent with the view of the father's

importance in sex-typed behaviors,[3] both boys and girls perceived their fathers as more encouraging toward the study of mathematics than their mothers. This was always true except for 10th grade girls. At this point fathers were no more encouraging than mothers and both parents were perceived as more positive by boys. Tenth grade marks the end of the usual amount of math taken by girls. Hereafter the percentage of girls, especially those of only mediocre math achievement, dropped off in comparison to boys.

As counselors and teachers one can clearly pinpoint the 10th grade as a time of special need for intervention.[4] It is also clear that one must not forget the importance of the father in contacts with the parents. Special attention also needs to be paid to those girls of only mediocre achievement in mathematics. While they will presumably never become mathematicians, they may nonetheless derive considerable benefit from further study of mathematics.

Girls at the high school level perceived their teachers as less positive toward them as learners of mathematics than did the boys. This difference was greatest at the 10th grade. In a pilot study of high school students, when asked what had discouraged them most about the study of mathematics, one third of the girls compared to only one tenth of the boys mentioned a teacher.

The lesson here is obvious. Teachers must be careful to encourage girls and not to discount the importance of mathematics for them. Again the 10th grade level is apparently a point of maximum need. There appears to be a real need for consciousness raising among math teachers.

Mathematics was generally perceived as more useful by boys, again especially in the 10th grade math classes. One wonders if girls realize how much mathematics is needed in even such traditional areas as nurse's training. Here is an obvious area for counselors to intervene with the girls themselves and their mothers and fathers.

Mathematics was always seen as more of a male domain by the boys than by the girls. Among the middle school students, mathematics was substantially correlated with the math achievement measures, from .32 to .45 for girls and from .16 to .36 for boys. Generally for both sexes lack of stereotyping math as a male domain correlated with higher scores on the cognitive measures and positive attitudes. This is consistent with the view that more secure people stereotype less. Not stereotyping math as a male domain correlated significantly but at a much lower level with math achievement among high school girls and not at all for high school boys.

These data suggest that girls must be under male peer pressure that mathematics <u>is</u> a male domain and not territory where they belong. This is probably a very important factor. In fact, the area of the city that stereotyped mathematics most as a male domain was the area of the city where the most sex-related differences were found at the high school level. This suggests that the sex stereotyping of math and male peer opinion are negative factors influencing girls away from mathematics.

For counselors and teachers, this finding suggests that boys themselves need to become less stereotyped in their views of girls. I guess

we're going to need boys' consciousness raising groups. If male peer opinion deters girls from studying mathematics, what might a counselor or teacher do to intervene? The possibility certainly exists of some salutary discussion of these questions in the classroom. However, one effort to reduce sex role stereotyping in the schools found that some classes of 9th grade boys became more stereotyped after the intervention. This indicates the clear need for evaluation of such efforts.[5]

The attitude toward success scale consisted of items expressive of discomfort about being successful in mathematics. It seemed to function as a kind of index of anti-intellectualism. At the high schools of lower socio-economic status, the girls' attitude toward success in mathematics was more positive than the boys' while in the high schools of higher socio-economic status, the girls were less positive toward success in mathematics than the boys. This is consistent with the hypothesis that learning actually changes sex-typing from the lower to the higher classes, i.e. that learning is considered female in the lower classes and male in the higher classes.[6] This means that sanctions against success in mathematics are probably stronger for girls in the higher classes. Unfortunately these are also the girls who could most easily afford advanced training.

Counselors of girls from higher socio-economic groups need to be especially alert to this problem. It is among these girls that math-science inhibition due to sex-role conflicts may be most acute.

Confidence in learning mathematics was lower in girls in nearly

all comparisons and confidence was moderately correlated with math achievement at all grade levels. This variable appears to be very important. Why should girls be less confident of learning mathematics when their grades and achievement scores are so similar? In fact, city-wide girls showed less confidence in their ability in math in the 6th grade, long before there could possibly have been any reason for them to think they could do less well on the basis of their actual performance. I strongly suspect that girls have less confidence in their ability because they have understood that females are not supposed to be as competent as males especially not in math. Exactly how they acquire less confidence and exactly how one would reverse this process is an important research question.

One further observation from the data which serves to underscore the importance of socio-cultural factors. The attendance areas where sex-related differences in math achievement were found were the ones which also showed many more sex-related differences in attitudes. It should also be noted that such a pattern of findings is not supportive of genetic views of sex-related differences. If genes are the source of sex-related differences in mathematics, why should girls do as well as boys in some high schools but not in others?

In summary, I think that counselors and teachers can feel they have a very positive and creative role in encouraging girls in the area of mathematics. Girls in the 10th grade are particularly subject to risk of premature opting out of the mathematics curriculum, however, the drop out continues through college and graduate school. Teachers

and counselors need to make more of an effort to encourage girls, including those who aren't the most brilliant, to continue their mathematical studies. Girls and their mothers and fathers need to become more aware of the likelihood that they will be engaged in paid work as adults and that mathematics is increasingly necessary for many areas of study. In counseling students, it is clear that fathers should not be forgotten. I have often wondered how enrollment in mathematics courses would be affected by some simple literature sent home before registration for 11th grade classes. Many implications of this research can readily be acted upon. I hope that we will gain increasing understanding of how girls acquire less confidence and that intervention programs will be implemented and evaluated for effectiveness.

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[3]The potential importance of father to sex typing is brought out in the paper of Jeanne Block, Conceptions of sex role: Some cross-cultural and longitudinal perspectives. American Psychologist, 1973, 28, 512-526.

[4]At the convention Lynne Fox questioned me on my emphasis on intervention in 10th grade and I would like to clarify that point. This time seemed to be of particular importance especially for easy, simple interventions such as information disseminated to parents and students. In the sample reported, 10th grade was the last year of math enrollment for many girls. Obviously the time for simple intervention is sometime before that decision (not to continue) is made. In some samples that decision may be made in earlier or

later grades. Other kinds of intervention would necessarily begin much earlier and there is probably need for intervention in all grades and levels of education. Comments about 10th grade should not be construed to rule out such efforts, but merely to pinpoint an obvious time for simple, massive intervention.

[5] I refer here to the study by Marcia Guttentag and Helen Bray, Undoing Sex Stereotypes, being prepared for publication.